DOES TALK MATTER AFTER ALL? INFLATION TARGETING AND CENTRAL BANK BEHAVIOR

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Abstract

Since 1990, a number of countries have adopted inflation targeting as their declared monetary strategy. Interpretations of the significance of this movement, however, have differed widely. To some, inflation targeting mandates the single-minded, rule-like pursuit of price stability without regard for other policy objectives; to others, inflation targeting represents nothing more than the latest version of cheap talk by central banks unable to sustain monetary commitments. Advocates of inflation targeting, including the adopting central banks themselves, have expressed the view that the transparency and communication of the inflation targeting framework grant the central bank greater short-run flexibility in pursuit of its long-run inflation goal.

This paper assesses whether the talk that inflation targeting central banks engage in matters to central bank behavior, and which interpretation of the strategy is consistent with that assessment. We distinguish five distinct interpretations of inflation targeting, consistent with various strands of the current literature, and characterize those interpretations as movements between various strategies in a conventional model of time-inconsistency in monetary policy. The empirical implications of these interpretations are then compared to the response of central banks to movements in inflation of three countries that adopted inflation targets in the early 1990s.

For all three, the evidence shows a break in inflation's time series properties consistent with a strengthened commitment to price stability. In no case, however, is there evidence that the adoption of an inflation targeting strategy entails a single-minded pursuit of the inflation target. For the U.K. and Canada, the results are generally consistent with adopting banks' own interpretation of inflation targeting, i.e., successful approximation of the optimal state-contingent rule. For these central banks, lower inflation levels and persistence are combined with greater accommodation of real shocks *and* more stable private-sector inflation expectations than seen prior to adoption. The results for New Zealand are more a mix of increased conservatism and trust, perhaps reflecting the more rule-like strictures of that nation's targeting framework.

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Since 1990, a number of economies — including Australia, Canada, Finland, Israel, New Zealand, Spain, Sweden, and the United Kingdom — have adopted inflation targeting as their declared monetary strategy, and the European System of Central Banks is relying on it as part of a hybrid approach.[1] Yet, to many observers, it is not entirely clear how inflation targeting in practice serves the purpose asserted for it in theory. If inflation targeting simply consists of the central bank (or the controlling government) announcing its inflation goal — the π^* in the familiar rules-versus-discretion models following Kydland and Prescott (1977) and Barro and Gordon (1983) — it either is providing the private sector with information already presumed to be known in these models, or it is making a less than credible claim (in the sense of actions not talk defining weak versus strong types as in Cukierman and Meltzer [1986]). If inflation targeting is instead a commitment that the central bank will target inflation with too little regard for other goals — the characterization given in Friedman and Kuttner (1996) and in various countries' political discussions — it is merely a limiting-case for the Rogoffian (1985) conservative central banker rather than a new type of monetary strategy, let alone a welfare-improving one.

The matching of model and operational practice is made more complicated by the institutional patterns which have emerged amongst inflation targeting central banks. As described in Mishkin and Posen (1997) and in Bernanke, et al. (1999), a largely consistent operational form has been adopted by all inflation targeting central banks implying a convergence on best practice. This operational form does begin with the public declaration of a numerical goal for inflation over a specified time-frame, but it does not end there. It also always includes a number of other elements, notably regular publication of an *Inflation Report*-type document, explaining the sources of inflationary pressures in the economy, as well as careful design and detailed public description of the target inflation series and range. Moreover, every inflation targeting central bank exhibits flexibility in response to economic shocks (whether or not granted formal "escape clauses") and gradualism in the pursuit of their inflation goals (see the case studies in Bernanke, et al. (1999) for details).

What, then, actually is inflation targeting? Does the central bank talk and institutional aspects associated with it serve a purpose, or is it solely verbal window dressing? If inflation targeting is instead

[1] Contemporaneous with this development, an academic literature on inflation targeting has arisen, led by the contributions of Svensson (1997a, 1997b, Svensson and Faust 1998). Other works include Ball (1998, 1999), Bernanke and Mishkin (1996), Bernanke and Woodford (1997), Haldane, ed. (1995), and Leiderman and Svensson, eds. (1995).

merely a shift in preferences, can this be consistent with the apparently measured rather than crusading pursuit of low inflation by inflation targeting central banks? This paper distinguishes five different possible interpretations of inflation targeting consistent with various strands present in the current literature. The existence of so many viable interpretations of inflation targeting may indicate that current academic discussions — and policy regimes — have taken the effects of this new monetary regime on central bank behavior for granted.[2]

Part 1 builds on the simple models of King (1997) and Svensson (1997a), to derive the implications for central bank behavior and inflation expectations of three different types of central bankers (untrusted discretionary, strictly conservative, trusted OSCR-following). Part 2 maps five different characterizations of inflation targeting onto shifts between specific pairs of these types of central bankers. Part 3 examines the hypothesized shifts in central bank behavior associated with each shift (and interpretation) empirically, both in terms of the time-series behavior of inflation, and of the impact of inflation surprises on long and short interest rates after adoption. Our results show that the adoption of inflation targeting in the United Kingdom, Canada, and, to a lesser degree, New Zealand, was associated with a reduction in both the level and persistence of inflation without an increase in the relative weight on inflation versus real goals. In the United Kingdom and Canada, accomodation of the real effects of inflationary shocks increased after adoption at the same time that long-run inflation expectations became more stable. Part 4 concludes that such a combination of results is consistent with the adoption of inflation targeting being a shift from discretionary or conservative central banking towards the optimal state contingent rule, and therefore may be characterized as a form of trust building by talking.

A MODELLING FRAMEWORK FOR INFLATION TARGETING

Models of monetary policy generally fall into one of two camps: those descended from Barro-Gordon (1983), which take expectations formation as the core problem; and those analyzing monetary policy's optimal control problem neglecting expectations formation.[3] The purpose of our investigation is not just to determine whether inflation targeting constitutes a regime shift, but whether the communication efforts that typically accompany an inflation targeting regime "matter," in the sense that they predictably affect the

[2] While there is a growing empirical literature on inflation targeting, most studies, such as Ammer and Freeman (1995), Laubach and Posen (1997a), and Johnson (1997) have examined inflation outcomes. Almeida and Goodhart (1997) is one study that explicitly considers central bank behavior.

[3] Examples of this latter group dealing with inflation targeting include Svensson (1997b), Ball (1999), and Cecchetti (1998).

behavior of the central bank and expectations of that behavior. Consequently, our modelling approach falls into the first of these two camps. In particular, we draw on the Svensson (1997a), and King (1997) extensions of the basic Barro-Gordon framework.

The problem of monetary policy in both classes of models is to manage aggregate demand in a way to minimize the deviation of output and inflation from their targets. Formally, the central bank is assumed to have a quadratic loss function in each period of the form:

$$\pi_t = a - b\epsilon_t - cy_{t-1} \ .$$

where π is the inflation rate and y can be interpreted as the output gap. We assume (without loss of generality) that the target rate of inflation is zero. For whatever reason, however, the CB may try to maintain output above potential; in this case, the target output gap, y^* would be greater than zero. The λ parameter represents the CB's weight on output stabilization vis à vis inflation; a value of zero indicates the CB cares *only* about inflation. The CB's preferences (i.e., the value of λ) are known to the public.[4]

Output obeys a Lucas-style aggregate supply relation,

$$y_t = \rho y_{t-1} + \alpha(\pi_t - \pi_t^e) + \epsilon_t \ ,$$

in which higher-than-expected inflation is associated with increases in output. This feature gives the CB an incentive to mislead the public with regard to its inflation objective in an attempt to create a "surprise" and increase output; consequently, absent a commitment mechanism, low inflation policies are typically not time consistent. The ϵ shock, as usual, is interpreted as a supply-side disturbance. Persistence is introduced through the inclusion of an autoregressive term, ρy_{t-1}.

We assume that private-sector inflation expectations are formed rationally before the ϵ disturbance is realized, so that $\pi_t^e = E_{t-1}\pi_t$. The CB *can* observe ϵ in real time, however, and sets policy contingent on its realization. This key assumption means the CB can play a constructive role in stabilization: when there is an adverse disturbance (a negative ϵ realization), the CB's optimal policy is to partially offset its effects on output by generating an inflation surprise. As shown by Rogoff (1985), appointing a conservative (lower λ than that of society's median voter) central banker, reduces the inflation bias, but results in more volatile output. King's (1997) "optimal state-contingent rule" (OSCR) is superior to that outcome, as discussed below, if only the central bank can be sufficiently trusted to pursue it.

[4] Interesting complications are introduced when the CB's preferences are unknown, but must be inferred by the public. Examples include Backus and Driffill (1985), Garfinkel and Oh (1995), Faust and Svensson (1998).

Central banks obviously do not set the inflation rate directly, however. Instead, they manage aggregate demand through the appropriate choice of interest rates. To model this, we assume aggregate demand is a simple function of the *ex ante* short-term real interest rate,

$$y_t = \delta(i_{1,t} - E_t\pi_{t+1} - r^*) \ ,$$

where $\delta < 0$, and r^* is the real rate consistent with a zero output gap. Conditional on period t expectations of period $t+1$ inflation, the CB chooses the nominal short-term interest rate $i_{1,t}$ consistent with the real rate that will yield the desired combination of output and inflation. This is tantamount to choosing π_t, of course, but this additional layer at least allows us to analyze the behavior of interest rates.

With output persistence, the problem becomes a dynamic one, and the policymaker must set i to minimize the discounted sum of the current and future one-period loss functions. In addition to the tradeoff between *current* inflation and output, the policymaker must also consider the effects of current actions on future realizations of those variables.

Discretion

Optimal policy under discretion can be described by a decision rule of the form

$$\pi_t = a - b\epsilon_t - cy_{t-1} \ .$$

The a coefficient, representing the time-invariant inflation bias, depends on the model's parameters just as it does in the static models of Barro-Gordon (1983) and King (1997), i.e., increasing in y^* and λ. The $-b\epsilon_t$ term represents the CB's optimal response to the supply shock; the CB will partially offset an adverse shock by increasing inflation. The degree of accommodation, naturally, will be greater for larger values of λ. Output persistence tends to increase these two terms whatever the relative weight on inflation goals. The inflation bias, a, will be larger because a given inflation surprise affects current and future output; the degree of accommodation also will be larger with persistence (an effect Svensson terms "stabilization bias").[5]

More interesting from our standpoint is the "state-contingent" inflation bias persistence introduces, embodied by the $-cy_{t-1}$ term in the decision rule. All else equal, a lower level of output increases the expected loss from the output term in the objective function, which the CB will attempt to offset through increased inflation. The private sector understands this, of course, and will come to expect the higher

[5] Further details, and a derivation of the policy rule, appear in Svensson (1997a).

inflation. In the end, inflation will be higher, but output will remain unaffected by policy.[6] It is this persistent effect of supply shocks on inflation on which we focus our empirical examination below.

The short-term (one-period) interest rate can be determined by equating aggregate demand with aggregate supply:

$$i_{1,t} = r^* + a + \delta^{-1}[(1 - c)\rho y_{t-1} + (1 - \alpha b + c\alpha b)\epsilon_t] \ .$$

In the presence of output persistence, the short-term rate will rise more than it would otherwise (provided the stabilization bias is not too large).

The pure expectations hypothesis can then be used to determine the long-term (two-period) interest rate as $\frac{1}{2}(i_{1,t} + E_t i_{1,t+1})$,

$$i_{2,t} = r^* + a + (\delta^{-1} - c)(1 + \rho)[\rho y_{t-1} + (1 - \alpha b)\epsilon_t] \ .$$

Again, the effect of the expected inflation term is to increase the response of the long-term rate.

Conservatism

The behavior of a weight-conservative "Rogoffian" central banker is similar, except λ in the social welfare function is replaced with some λ' describing the CB's preferences, where $\lambda' < \lambda$. As shown by Rogoff (1985) such a policymaker will respond suboptimally to supply disturbances, while delivering a lower average rate of inflation. As in the case of discretion, the state-contingent inflation bias resulting from supply shocks generates persistence in the response of interest rates, although the magnitude is attenuated relative to the discretion case.

An interesting limiting case of conservatism is King's (1997) "inflation nutter" for whom $\lambda' = 0$. As might be expected of a fanatic, this behavior generates highly suboptimal outcomes. In this case, $a = b = c = 0$, and inflation will equal its target (zero) in each period. The short-term interest rate will adjust to equate aggregate demand with supply

$$i_{1,t} = r^* + \delta^{-1}[\rho y_{t-1} + \epsilon_t] \ ,$$

[6] An odd feature of Svensson's original model is that over some range, expectations of future inflation fall as the weight assigned to output fluctuations increases. In the limiting case as $\lambda \to \infty$, an adverse supply shock has *no* effect on expected inflation. In that case, the inflation increase is sufficient to perfectly stabilize output, and with output constant, there is no change in the state-contingent inflation bias. This curious result would obviously not hold in a model characterized by persistence in the inflation process.

rising sharply to prevent an adverse supply shock from affecting inflation. The response of the long-term rate rise along with the short-term rate,

$$i_{2,t} = r^* + \frac{1}{2}\delta^{-1}(1+\rho)(\rho y_{t-1} + \epsilon_t) \ ,$$

but the expected inflation effect will be absent.

OSCR

Let us say that the CB acquires some sort of a mechanism that allows it to commit to a zero inflation rate. (In King (1997), that mechanism is an inflation target; we return to this interpretation in the next section.[7]) Since only inflation surprises affect output, the optimal policy, it turns out, is one in which the conditional expectation of inflation is always equal to its target, i.e., $E_{t-1}\,\pi_t = 0$. Consequently, supply shocks will have no persistent effects on inflation or monetary policy.

This result is derived formally in a dynamic model by Lockwood et al. (1995) and Svensson (1997a): if the CB can credibly commit to such a rule, the optimal decision rule takes the form

$$\pi_t = -b^* \epsilon_t \ ,$$

in which the time-variant inflation bias, a, disappears. More importantly, from our standpoint, is the disappearance of the state-contingent inflation bias, $-cy_{t-1}$, so that $E_t\pi_{t+1} = 0$. The reason for this is clear: since only "surprise" policy actions can affect output, it doesn't pay to respond to predictable output movements. Hence, an optimal rule will ignore them, and revert to the inflation target after responding contemporaneously to the shock. Empirically, this means adverse supply shocks won't generate inflation premia in long-term interest rates. After responding optimally by letting inflation rise for one period, the CB is trusted to return inflation to its optimal level once the shock has passed.

The corresponding movements in short- and long-term interest rates would then be given by

$$i_{1,t} = r^* + \delta^{-1}[\rho y_{t-1} + (1 - \alpha b^*)\epsilon_t] \ ,$$

and

$$i_{2,t} = r^* + \frac{1}{2}\delta^{-1}(1+\rho)[\rho y_{t-1} + (1 - \alpha b^*)\epsilon_t] \ .$$

[7] King's interpretation of an inflation target is as a mechanism that allows the CB to commit to a given (presumably zero) average rate of inflation (i.e., unconditional on ϵ) while allowing the CB to respond to realizations of the ϵ disturbance. Svensson (1997a) shows how state-contingent linear inflation contracts and state-contingent inflation targets with a weight-conservative central bank can be engineered to mimic the OSCR.

Besides the dependence on lagged *y* and the mean inflation bias, the OSCR and discretionary regimes also differ in the size of the response to the ϵ realization. Because future values of the output gap are affected by current policy actions, there is a tendency to respond more vigorously to shocks, resulting in a *b* that is larger in size than the b^* obtained under the OSCR.[8]

Summary

The response of central banks to macroeconomic shocks clearly should differ across these regimes. In understanding the way in which the responses differ, it is helpful to recognize the two mechanisms by which supply shocks affect interest rates. The first is the effect on the real interest rate resulting from varying degrees of accommodation of the shock by the central bank; the second is the expected inflation introduced by the state-contingent inflation bias. Table 1 summarizes the relative responses of the short- and long-term interest rates to an ϵ realization derived in this section. Comparing the response of central bank's policy instrument (captured in the short-term interest rate) across the three regimes yields the following predictions about the behavior of short-term interest rates:

- The instrument rate response to supply shocks in the "inflation nutter" regime is *greater than* that under the OSCR. Expected inflation is zero in either case, but under the OSCR, the CB will want to accommodate the shock to some extent, resulting in a smaller rise (in the case of a negative ϵ) in the short-term rate.

- The policy instrument response of the "inflation nutter" is *greater than* that under discretion (for $c < 1$). The same reasoning holds: the CB's desired accommodation under discretion outweighs the change in expected inflation.

- The central bank's response under discretion is comparable to that under the OSCR. The state-contingent inflation bias implies higher expected inflation (in response to an adverse shock), which implies a larger short-term rate response; stabilization bias implies a smaller (more accommodative) short-term rate response. (In a static model without output persistence, the response is the same under discretion and the OSCR.)

The analogous predictions for the long-term rate are:

- The response of private-sector inflation expectations in the "inflation nutter" regime is *greater than* under the OSCR. There is no state-contingent inflation bias in either case, but the larger real rate response by the inflation-only targeter yields a larger increase in long-term rate.

- The long-term rate response in the "inflation nutter" case may be greater or less than the response under discretion, depending on whether the larger real rate effect for the "inflation-only" targeter is greater or less than the discretionary CB's state-contingent inflation bias.

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[8] This result is driven by the endogenous nature of output persistence. With a serially uncorrelated but exogenous supply shock, the policy response under discretion and the OSCR would be identical. The result also depends on the lack of persistence in the inflation process.

- The response of inflation expectations to an inflation shock under the untrusted discretionary CB's is *greater than* the response under the OSCR (provided the stabilization bias isn't too large). The response of the short-term interest rate is similar under the two regimes (smaller for the discretionary CB due to the stabilization bias), but the lack of a state-contingent inflation bias under the OSCR removes the inflation premium in the long rate.

INFLATION TARGETING AS SHIFTS BETWEEN CENTRAL BANK TYPES

As noted in the introduction, there are several different ways commonly invoked of characterizing inflation targeting. Each one of these characterizations can be grounded to a greater or lesser degree in a portion of the extant monetary economics literature. To enable rigorous comparison of these characterizations with each other, and with reality, we need a common framework for generating differing hypotheses resulting from each interpretation . Our approach is to treat each characterization of inflation targeting as a switch by a central bank between a specific pair of the three types of central banker modelled above — the untrusted discretionary, the strictly-targeting conservative, or the trusted OSCR-following. Some characterizations require an additional distinction to be made between the inflation target adopting central

Table 1
Response of Interest Rates to Supply Shocks Under Alternative Policy Regimes

Regime	short-term rate	long-term rate	spread
OSCR	$\delta^{-1}(1-\alpha b^*)$	$\frac{1}{2}\,\delta^{-1}(1+\rho)(1-\alpha b^*)$	$-\frac{1}{2}\,\delta^{-1}(1-\rho)(1-\alpha b^*)$
Discretion	$\delta^{-1}(1-\alpha b+\alpha bc)$	$\frac{1}{2}\,(\delta^{-1}-c)(1+\rho)(1-\alpha b)$	$-\frac{1}{2}\,(\delta^{-1}-c)(1-\rho)(1-\alpha b)$
Inflation nutter	δ^{-1}	$\frac{1}{2}\,\delta^{-1}(1+\rho)$	$-\frac{1}{2}\,\delta^{-1}(1-\rho)$

banks on the basis of institutional design, rather than characterizing all adopting central banks as making the same move by announcing an inflation target.[9] With this unified framework, each interpretation of inflation targeting should be associated with a shift in the behavior of (some of) the adopting central banks in response to supply disturbances, as well as in the response of private-sector inflation expectations to the central bank's activities. Testing of those empirical predictions is the subject of the following section.

Inflation Targeting as Trust Building

[9] For example, according to some interpretations of Persson and Tabellini (1993) and Walsh (1995), only those inflation target adopting central banks with formal punishments for failure to meet the targets can be said to switch from the untrusted discretionary regime to the OSCR.

This is the interpretation of King (1997), that inflation targeting allows the central bank to (come close to) follow the optimal state contingent rule. In our framework, this would be a shift from either the discretionary or the conservative type of central banker to the OSCR-following. By providing greater information about its forecasts (and therefore about the nature of the disturbances it faces) and accountability for meeting those forecasts, the central bank gains in the flexibility with which it can respond to shocks. This interpretation would explain the pattern of inflation targeting central banks being able to convince the public that they can accommodate one-time inflationary shocks (e.g., the indirect tax rise in Canada in 1991; the United Kingdom exit from the ERM in 1992) without raising doubt about underlying counter-inflationary resolve, something a conservative central bank is not able to do. It also would explain why all inflation targeting central banks invest so many resources in *Inflation Reports* and other forms of public information provision.

If this interpretation is correct, all three inflation targeters (New Zealand, Canada, and the United Kingdom) examined here should be characterized by smaller movements in inflation expectations (embodied in long-term interest-rates) when the central bank deviates from the target due to unforeseen shocks than seen prior to announcement of inflation targets. In the case of a shift from a conservative or rule-based regime (such as an exchange rate peg) to the OSCR, inflation targeting should also increase the accommodation of shocks by the central bank.

Inflation Targeting as Strict Contracting According to some interpretations of the models of Walsh (1995) and Persson and Tabellini (1993) of optimal inflation contracts for central bankers, inflation targets can serve as such a contract, but require an explicit punishment mechanism for the central banker's failure to meet the target. This is, of course, embodied in the Reserve Bank Act of 1989 and the "Policy Targets Agreements" in New Zealand. Discussions in that country leading up to target adoption make reference to these sorts of ideas as part of the justification for the design of their regime.[10] Within our framework, the strict contracting interpretation is still characterized as a shift from discretion or conservatism to the OSCR, with the same empirical predictions, but these should only hold for New Zealand in our three country sample.[11] In this characterization, the

[10] See Bernanke, et al (1999), Chapter 5, for details.

[11] Some could claim that recent additions to the United Kingdom's inflation targeting framework also serve to make the Bank of England strictly contracted. Even were one to accept this interpretation, which appears to us to unduly stretch the meaning of the term "contract", it would apply for only part of the time the Bank of England has been independent, and certainly not to the 1992-1997 period which constitutes most of our sample.

talk and institutional design of inflation targeting alone are insufficient to shift the central bank's type without such a contract.

Inflation Targeting as Chatty Conservatism

This is an interpretation widespread among inflation targeting skeptics. Worldwide, there is evidence of central banks becoming more conservative with respect to inflation goals. The conservatism could be the result of intellectual commitment to the primacy of the price stability goal as the forward march of knowledge continues, of pressures from internationally integrated capital markets, or of a general desire to be like the fashionable central bankers of the day. In our framework, this characterization of inflation targeting is represented by a shift from discretion to greater conservatism on the part of the central bank. The institutional aspects of inflation targeting dedicated to transparency should then be seen as mere window dressing or as political concessions necessary for central bankers to maintain this desired shift — either way, the act of central banks talking about their inflation forecasts and publishing detailed reports is a side show. Under this interpretation, talk does not indicate movement towards the OSCR.

This interpretation fits nicely with the fact that both the Bank of Canada and the Reserve Bank of New Zealand expressed explicit commitment to a primary goal of price stability prior to the announcement of inflation targets, while the United Kingdom had joined the ERM in 1990, and all three of these commitments followed years of frustration and disappointment with (what were perceived as) looser monetary strategies. Were this the proper interpretation, the adopting central banks would display diminished accommodative flexibility in response to disturbances. The effect on long-term rates' response to inflation shocks is less clear - as derived in the previous section, the long-term rate response may be greater or less than the response under discretion, depending on whether the larger real rate effect for the conservative targeter is greater or less than the discretionary CB's state-contingent inflation bias. Even when the stability of inflation expectations increases, however, the decline in response of expectations is smaller than that expected were the move to be towards the OSCR instead.

Inflation Targeting as Inflation-Only Targeting

Some would hold that inflation targeting is actually inflation-*only* targeting (to use Ball's [1999] phrase), where inflation targeting literally means that the central bank takes only its inflation goal into account when setting policy. Given the tenor of some proposals in the United States Congress in the 1990s (before it apparently adopted the opinion that current Federal Reserve policy could not be improved upon), and Galbraith's (1999) characterization of inflation targeting as a sign of inflation obsession without any regard

for transparency, this view is shared by some inflation targeting advocates and opponents. In our framework, this characterization is the limiting case of the previous, where the shift is to an "inflation nutter" central bank from any lesser degree of conservatism. Inflation-only targeting predicts (when modelled) a shift to near-total inflexibility of monetary policy in response to shocks with far from optimal results.

Rhetoric aside, there is essentially no institutional or historical evidence for such an "inflation-only targeting" interpretation of the intent of most central banks publicly announcing inflation targets in the 1990s, as documented in Bernanke, et al. (1999). Nevertheless, it is more than a straw man or a test of the literalness of language to examine this characterization of inflation targeting. Even if the central bank in question were to have a typically mixed-goal perspective, a la Bernanke and Mishkin (1996), an inflation target designed to be very strict for reasons of accountability could unintentionally still mimic the nutter with significant costs.[12] When almost all inflation targets have central values only a small amount over the measurement bias in price indices, and those targets with ranges are much narrower than what simulations would indicate are confidence intervals for inflation control, it is plausible that these targets strictly enforced (perhaps by a legislature) would constitute something close to inflation-only targeting. These structural or technical sources of *de facto* conservatism seem particularly likely to matter for a small open economy whose vulnerability to inflation shocks is high.

Inflation Targeting as Cheap Talk of the Weak

An even more skeptical interpretation of inflation targeting than the preceding views is that those central banks which can credibly commit to low inflation do so, and those who cannot, talk about so doing. Central banks which adopt inflation targeting are those banks which have run out of alternatives because they cannot adhere to fixed exchange rate commitments, monetary targeting, or other rule-like behavior. A theoretical grounding for this view is given in Cukierman and Meltzer (1986) and Garfinkel and Oh (1995). In these analyses, the central bank suffers from a two-fold credibility problem: the bias from the possibility of discretionary surprise, and the existence of private information regarding disturbances known to the central bank. By this characterization, talk alone (such as publication of *Inflation Reports* and

[12] Friedman and Kuttner (1996) took on the dangerous implications of just such a rule-like policy regime as a warning against inflation targeting in the spirit of then-current congressional proposals for the Federal Reserve.

forecasts) cannot credibly commit the bank to reveal its private information, and so cannot get the central bank to the OSCR.[13] In fact, talking about goals and forecasts is a sign of weakness.

In our framework, therefore, this characterization is represented by a shift in central bank types from conservatism towards greater discretion. For our sample countries, such an interpretation of inflation targeting seems to make sense only for the United Kingdom, if one were to interpret the exit from the ERM as a sign of weakness.[14] It is more difficult to imagine what made either the Bank of Canada or the Reserve Bank of New Zealand "weaker," in terms of the credibility of their commitments to price stability, at the start of the 1990s than at their already less than credible starting point of the mid-1980s. Empirically, such a shift would imply the reverse of that described as "chatty conservatism," i.e., the central bank would be more accommodative of disturbances, and private-sector inflation expectations would be more responsive to that accommodation.

The mappings of each of the five characterizations of inflation targeting, discussed in this section, on to a shift between a specific pair of central bank types, from section 1, and the empirical implications of those shifts for the behavior of central banks and of inflation expectations, are summarized in Table 2.

THE EFFECTS OF INFLATION TARGETS IN PRACTICE

The goal of this section is to detect empirically changes in central bank behavior following the adoption of inflation targets, and to characterize those changes in terms of the shifts between central bank types set out in section 2. The investigation focuses on the properties of inflation, the reaction of monetary policy to inflation and real activity, and the response of policy and interest rate expectations to inflation surprises.

We proceed in two steps. The first is to test the null hypothesis that inflation targeting has no effect on central bank behavior (or inflation expectations) by examining the time series properties of inflation itself. One seemingly obvious test would be to compare the average inflation rate pre- and post-target; if the target is more than "just talk," the inflation rate should fall. Central banks may choose to announce inflation targets following a favorable inflation shock, however, so a reduction in average

[13] We are grateful to Michelle Garfinkel for an extended elucidation of these models, but we remain responsible for this interpretation and any errors herein.

[14] Sweden, another inflation targeted not analyzed here, could be characterized in the same way.

inflation does not necessarily imply a change in behavior.[15,16]

A more revealing comparison involves the *persistence* of inflation before and after the adoption of inflation targets, rather than its level. A key insight of the model discussed in section 1 is that successful inflation targeting — whether achieved through the OSCR or by attaching zero weight on output fluctuations — will lead to $E_t \pi_{t+1} = \text{constant} = \pi^*$. In this case, inflation fluctuations will not persist; higher-than-expected inflation at time t will have no implications for inflation in period $t+1$ and beyond. By contrast, if the central bank's behavior is governed by unchecked discretion, then an unfavorable shock will increase inflation in subsequent periods by virtue of the state-contingent inflation bias.[17] Clearly, zero persistence represents a limiting case; more generally, an increase in conservatism or in trust of the central bank will tend to reduce inflation persistence.

While a decrease in inflation persistence signals a change in policy regime, it says nothing about the nature of that change. The second step, therefore, is to see whether the change was achieved through the adoption of more conservative preferences by the central bank — the "chatty conservatism" or "inflation-only targeting" cases — or through trust-building, which would move policy towards the OSCR (whether for all adopting countries, or only for those which take on "strict contracting"). To distinguish between these two possibilities, we rely on the model's implications for the behavior of interest rates, and their response to inflation.[18]

One tactic for uncovering changes in policymakers' preferences is estimate a Taylor-style policy reaction function, and look for a change in the relative weights on the real activity and inflation terms. The target short-term interest rate, r^*, taken to be the operating instrument of monetary policy, is assumed

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[15] See Mishkin and Posen (1997) and Almeida and Goodhart (1998) for evidence of this pattern.

[16] A test with similar limitations would be to assess whether the adoption of inflation targeting reduces the "sacrifice ratio", lowering the cost in terms of foregone employment of a given reduction in inflation. This approach requires additional assumptions about the responsiveness of labor markets to variations in monetary regimes which are largely unsupported for low inflation countries (see Posen [1998]), and which no inflation-target adopting central bank expected to occur over the short lifespans of those regimes to date (see Bernanke et al. [1999]). Hutchison and Walsh (1998) give an alternative view on the New Zealand experience, claiming some shift. In the model discussed above, however, the structural parameter describing the output-inflation tradeoff doesn't change when a new policy regime is adopted.

[17] A similar insight is exploited by Ireland (1998) in testing whether the time consistency problem can account for the behavior of U.S. inflation.

[18] The last interpretation listed in the previous section, inflation targeting as "cheap talk of the weak," could also be tested in this manner. Should the null of no effect of inflation targeting be rejected due to a decline in inflation persistence, however, there is no reason to expect this interpretation to be supported (if anything, it would lead one to expect a rise in inflation persistence). None of the three countries in our sample show such a rise in persistence, so in the interests of brevity we do not continue to carry on discussion of this possible interpretation here.

to depend on the inflation and unemployment "gaps":

$$r_t^* = \alpha + \beta(E_t\pi_{t+k}^k - \pi^*) + \gamma(u_t - u^*)$$

where π^* is the central bank's inflation target, $E_t\pi^k_{t+k}$ is expected inflation over some horizon k, u_t is the unemployment rate, and u^* is its target. As in Clarida et al. (1998), a partial-adjustment specification is used to capture central banks' tendency to smooth interest rates,

$$r_t = (1-\rho)r_t^* + \rho r_{t-1} + e_t \quad .$$

Average inflation rate over the preceding six months, π^6_t, is used as a proxy for expected future inflation. The two equations can then be combined to yield the following regression equation which can be estimated using OLS:

$$r_t = b_0 + b_1\pi_t^6 + b_2 u_t + e_t \quad .$$

The target inflation and unemployment rates are subsumed into the constant term, while the b_1 and b_2 coefficients can be interpreted as $(1-\rho)\beta$ and $(1-\rho)\gamma$, respectively. If inflation targeting involves the adoption of more conservative preferences, we would expect to see an increase in b_1 relative to b_2; in the trust-building case, no change would be expected.

The reaction function approach has its limitations, however, as it says nothing directly about the response of private-sector expectations of inflation and of future monetary policy. As noted at the start of section 1 above, if we are interested in assessing the importance of central bank talk to the public, we must look at expectations as well as at the central bank's control problem. In addition, in the limiting case where inflation targeting is completely successful, current values of inflation and unemployment would be uninformative about *future* inflation, making the estimated b_1 coefficient difficult to interpret as a coefficient on expected inflation.[19]

Our second tactic is to examine the response of short-and long-term interest rates to inflation *surprises*. As discussed in section 1, the response of bond rates provides information about expectations of

[19] In this limiting case of perfect inflation targeting, the policy instrument would be manipulated in such a way as to keep expected future inflation constant, making inflation fluctuations unforcastable. Consequently, the inflation term in the reaction function would be uninformative about *future* inflation, which is presumably the policymaker's objective. Even a less-than-perfect inflation target, if it sufficiently reduced the correlation between lagged variables and future inflation, could create finite-sample problems for the instrumental variables estimation procedure of Clarida, Galí, and Gertler (1998) (see Staiger and Stock [1997]). Bernanke and Woodford (1998) discuss related theoretical issues raised by targeting expected inflation. For purposes of the investigations conducted in this paper, the problem is sufficient to justify use of our second tactic, as well as these estimations, but insufficient to completely invalidate the procedure, given the likely imperfections of any monetary strategy.

inflation and future policy actions, which will differ across central bank types.[20] Inflation's unforecastability is not an issue here; even though expected inflation is constant under a perfect inflation target, the central bank will respond to *unexpected* changes in the inflation rate in such a way as to maintain expectations and return inflation to its target. As summarized in Tables 1 and 2 above, comparisons between the magnitude of the response of short- and long-term rates pre- and post-target can be used to characterize the nature of the shift in central bank types associated with adoption of inflation targeting. A larger response of short-term interest rates should be associated with the "chatty conservatism" or "inflation-only" cases. There would be no such change in the "trust-building" case; rather, the response of long-term rates to inflation surprises would be attenuated.

To characterize the response of monetary policy and expectations to inflation shocks, we use impulse response functions from a VAR involving inflation, unemployment, short- and long-term interest rates. The identifying assumptions used to extract an inflation shock from the VAR are broadly consistent with our model, and with conventional timing assumptions. Specifically, we allow inflation shocks to affect unemployment contemporaneously, consistent with its interpretation as a supply disturbance. As expectations presumably react immediately to news, the bond rate is allowed to respond contemporaneously to inflation, unemployment and monetary policy shocks. Finally, consistent with our assumptions about the central bank's information set, monetary policy is assumed to respond to current-period values of inflation and unemployment.[21]

United Kingdom

We turn first to the results for the United Kingdom, which adopted an inflation targeting policy after exiting the ERM in September 1992. In terms of explicit intent and design, the Bank of England's framework comes closest to the model of using institutionalized transparency to achieve the OSCR (see King [1997] and Bernanke, et al. [1999], ch. 7). Unlike in Canada and New Zealand, changes in the Bank's mandate, independence, and governor all took place *after* inflation target adoption, making this in some sense the cleanest test of inflation targeting itself. On the face of it, the U.K.'s adoption of an

[20] Another strategy focused on expectations involves comparing measures of inflation expectations with the central bank's stated inflation target, as in Svensson (1993) and Johnson (1997). While this provides some evidence on the credibility of the target, it cannot distinguish between interpretations of inflation targeting as an increase in trust or in conservatism.

[21] Ruled out by this identification scheme are contemporaneous effects from unemployment to inflation, from monetary policy to inflation and unemployment, and from bond rates to any of the other three variables. This leads to a just-identified triangular decomposition of the covariance matrix that is similar, but not identical to the standard Choleski factorization.

inflation target would appear to be clearly untinged by a movement towards increased anti-inflationary conservatism; if anything, the unwillingness to remain in ERM and sacrifice domestic real-side goals for the sake of a strong pound and price stability would seem to be a sharp break towards OSCR-like discretion. On the other hand, as discussed in section 2 above, if any of the three targeters could be interpreted to be replacing an anti-inflationary commitment with cheap talk, it would also be the forcibly devaluing United Kingdom.

The experience under an inflation target is compared with the period from 1984 through 1989. The two years in which Britain participated in the ERM, and the eight months leading up to it, are excluded from the analysis on the grounds that the period represents a brief interregnum, dominated by transition dynamics in and out of that regime.[22] As with all three inflation targeters examined here, the average rate of inflation is indeed lower during the targeting period: 2.7 percent, compared with 4.5 percent for the 1984–9 period.

Table 3 reports measures of inflation persistence, and changes in its behavior between the two subsamples. These, and subsequent, results are based on monthly data, and inflation is calculated from seasonally-adjusted RPIX (the Bank of England's target inflation series, excluding the first round effects of interest rate rises on prices). One simple measure of persistence is the sample autocorrelations, reported in panel A of Table 3. In the 1984–89 period, inflation exhibited positive serial correlation, with a first-order autocorrelation coefficient of 0.31. This changes with the adoption of an inflation target: over the 1992–97 subsample, the autocorrelations are all close to zero, or negative.

This finding is confirmed in the time-series regressions of inflation on lagged inflation and unemployment reported in panels B and C. In panel B, the regressions are run on pre- and post-target subsamples separately. Over the earlier period, the coefficients on the first lags of inflation is positive (although not statistically significant); the coefficient on lagged unemployment is negative and highly significant.[23] This pattern changes after the adoption of inflation targets. The coefficient on first lag of inflation is effectively zero, while the coefficient on the second lag is negative and statistically signficant. The unemployment rate no longer enters significantly. Panel C confirms the statistical signficance of the

[22] Unusual inflation volatility which characterized this period — including one month in which the annualized rate exceeded 20 percent — is another reason to exclude the months leading up to the ERM. The results are qualitatively similar if this period is included, however.

[23] The model outlined in section 1 implies a positive correlation between unemployment and inflation, rather than the negative correlation found in the data. The observed negative correlation is probably the result of demand shocks, which are absent from the model.

changes in coefficients on unemployment and the second lag of inflation. The reduction in the persistence is inconsistent with the suggestion that "cheap talk" replaced the discipline imposed by the ERM.

Table 4 reports an estimate of the reaction function allowing the b_1 and b_2 coefficients to change with the adoption of the inflation target. (The equation also includes a time-varying constant, which is not reported.) Although there is some weak evidence for shifts in the coefficients, for the reasons discussed above, the interpretation of these changes requires some discussion. The most noticeable change between the subsamples is in the coefficient on inflation, which falls to an insignificant 0.09 from a highly significant 0.25. (Given the coefficient on the lagged interest rate, this implies $\beta = 1.56$, a greater than one-for-one response of the overnight rate to inflation). This would be consistent with a move towards the OSCR, and certainly opposite from a move towards greater conservatism.

The post-target coefficient is estimated very imprecisely, however, so the difference in the two coefficients is not statistically significant. The zero coefficient may indicate a reduced weight on inflation, but it also may simply reflect the fact that lagged inflation has become less informative about future inflation. At the same time, there was a slight increase in the weight on unemployment. Neither unemployment coefficient is statistically significant, however; nor is its change between subsamples.

Results of our third test for the U.K., concerning the interest rate response to inflation shocks, are more distinct, and suggest a shift from a discretionary policy regime to one approximating the OSCR. The results appear in Figure 1, where the solid line is the estimated impulse response function, and the dotted lines represent the bounds of the 95% confidence interval. Pre-target, the response is sharp: a one percentage point (annualized rate) inflation shock generates an increase in the short-term rate peaking at 20 basis points, and an increase in the long rate of roughly 7 basis points. Both are significant at the .05 level. Considered in isolation, the interest rate responses prior to inflation target adoption are difficult to interpret. In the model of section 1 above, inflation shocks elicit a contractionary policy response regardless of policy regime (including discretion). Similarly, the rise in bond rates may reflect an increase in inflation expectations (consistent with a "weak" central bank), or it may embody higher expected real short-term rates (consistent with a "conservative" central bank).

Comparing the pre-target with the post-target responses in Figure 1 is more revealing about the nature of the regime change. Inflation targeting is associated with an attenuated response of both short- and long-term rates: the increase is only 3 basis points for both maturities, and neither response is significant at the 0.05 level. Given the wide confidence interval associated with the pre-target impulse response functions, a formal test of equality between the two would fail to reject the hypothesis of no change. Nonetheless, it is hard to reconcile the muted (and precisely-estimated) post-target policy

response with an increase in conservatism, let alone a move to "inflation-only targeting," which would imply a significant amplification in the response of both interest rates. Furthermore, the absence of a significant rise in the bond rate, along with the diminished inflation persistence, rules out the "cheap talk" interpretation. Instead, the reduced inflation persistence, milder policy response and lack of an "inflation scare" in bond rates post target are all consistent with the "trust building" interpretation of inflation targeting.

Canada

As seen in the United Kingdom, Canadian inflation fell by about 2.5 percent (from 3.8 to 1.3 percent) following the adoption of inflation targets in February 1991.[24] Unlike what was seen in the United Kingdom, however, there is little evidence of a change in the time-series properties of inflation post-adoption. As shown in Table 6, the inflation rate is, essentially, serially uncorrelated both before and after this date. The autocorrelations reported in panel A are all small, and those that are non-zero tend to be negative. This result is underscored in the inflation regression reported in panel B, where the coefficients on lagged output and inflation are small and statistically insignificant in both subsamples. Diagnostic LM tests show no evidence of higher serial correlation, and the R^2s from the two regressions are 0.01 and 0.04, respectively. Apparently, nothing forecasts Canadian inflation — a finding inconsistent with discretionary policy either pre- or post-target.[25] One possible explanation, if Canadian inflation targeting represents an increase in conservatism, is that the relevant regime change can be dated prior to the adoption of the inflation target, to the appointment of Governor John Crow at the Bank of Canada, or to his Hansen Lecture of 1988 declaring price stability to be the sole long-run goal of Canadian monetary policy (see Mishkin and Posen [1997]).

The question remains open, however, as to whether the Bank of Canada achieved these results through conservatism, or through trust-building. The estimated reaction function reported in Table 6 sheds ittle light on this question, perhaps because of the lack of predictability in Canadian inflation. The coefficients on the average inflation rate are small and statistically insignificant, as are the coefficients on the unemployment rate. One plausible interpretation of these puzzling results is that, despite the stated policy of inflation targeting, Canadian monetary policy has been more focused on the exchange rate.

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[24] These figures, and the results which follow, are based on the target inflation measure obtained from the Bank of Canada that removes the effects of changes in the Goods and Services Tax (GST).

[25] Obviously, there are other factors — the exchange rate, commodity prices — that might be related to Canadian inflation. But none of these omitted variables generate serially correlated movements in inflation.

Indeed, even after February 1991, the Canadian overnight rate has been punctuated by sharp increases without any apparent link to domestic economic conditions.[26] Shifts in fiscal policy may also have been a factor affecting monetary policy (see, e.g., Clinton and Zelmer [1997]).

Clearer evidence is provided by the impulse responses from the VAR, which show smaller policy and bond rate responses post-target. As shown in Figure 2, a 1% inflation shock elicited a sharp, statistically significant 15 basis point response in the overnight rate pre-target; post-target, the response is not statistically distinguishable from zero. The response of the bond rate goes from a barely-significant 5 basis points pre-target to essentially zero post-target. As in the U.K., the attenuated policy response and non-response of bond rates post-target together rule out a sharp increase in conservatism, and the combination, along with the lack of any inflation persistence, is broadly consistent with the trust-building interpretation of inflation targeting.

New Zealand

The last case considered is that of New Zealand, which adopted inflation an inflation target in January 1990.[27] As with the U.K. and Canada, average inflation has been lower post-target: 1.9 percent, versus 8.1 percent over the 1982 through 1990 period. And like the U.K., the inflation rate exhibits much less persistence after the adoption of the inflation target, as shown in Table 7. Prior to 1991, the autocorrelations, reported in panel A, show a great deal of positive serial correlation; after 1991, they become small and generally negative. In the inflation regression reported in panel B, the AR(1) coefficient drops from 0.65 pre-target to essentially zero post-target, with no evidence of residual correlation or an omitted lag on inflation. While this difference is striking and large enough to be economically meaningful, it is statistically insignificant. The effects of the unemployment rate on inflation are small and statistically insignificant in both subsamples.

The estimated reaction function coefficients reported in Table 8 are consistent with a strong policy response to expected inflation both pre- and post-target. Before target adoption, the coefficient on the inflation rate is a highly significant 0.42. (The two-quarter average, π^2_t, takes the place of the six-month average used in the monthly regressions reported in the UK and Canadian cases). With a coefficient of 0.59 on the lagged short-term rate, this implies a roughly one-for-one response of the interest rate to

[26] Notable examples include a 300 basis point increase in early 1986, a 270 basis point spanning late 1992 and early 1993 — both rapidly reversed — and, more recently, a 100 basis point increase in September 1998.

[27] Monthly data on inflation and other variables are not available for New Zealand. The small number of quarterly observations in the pre- and post-target subsamples, severely limits our ability to make precise inferences from the data.

expected inflation. The size of the coefficient increases somewhat post-target to 0.65, but the difference is not statistically significant. On another criterion, monetary policy shows more of an accommodative response to real activity post-target, with the coefficient on the unemployment rate going from a statistically insignificant 0.57, to a significant –0.18. The change in the coefficient is itself significant.

The results from the VAR-based impulse response functions also show a stronger response to inflation shocks since the adoption of the inflation target. As depicted in the upper-left panel in Figure 3, the two-quarter response of the short rate pre-target was roughly 40 basis points; post-target, it is nearly 70.[28] Both are statistically significant, but the large standard errors associated with the post-target response would not formally reject a no change hypothesis. Similarly, the response of the bond rate post-target is nearly four times as large, but this response is very imprecisely estimated.

The reduction in the level and persistence of New Zealand's inflation rate clearly show a significant change in policy accompanied the adoption of the inflation target. Although most of the evidence on the behavior of interest rates arguably points to the "chatty conservatism" interpretation, the change of sign to a significant negative short-term interest rate to unemployment post-target muddies the picture somewhat. As in the United Kingdom and Canada, there is no evidence to suggest an "inflation-only targeting" scenario. The increase in conservatism seen in New Zealand appears more in keeping with the discussion in section 2 above, where New Zealand's explicit contracts and low and narrow target range (considering the economy's small size and high degree of openness) lead unintentionally to greater conservatism.

Taken in conjunction with the results from Canada and the U.K., it is also clear that the New Zealand evidence does not support the "strict contracting" view of inflation targeting. The tight contraints imposed by the New Zealand framework did not produce noticeably lower inflation persistance or a closer approximation to the OSCR (in the form of greater trust by long bond rates) than the less strict — though still transparent — regime of the United Kingdom. In fact, the apparent failure of the New Zealand strict contracting approach to dampen the response of policy and of inflation expectations to inflation shocks underscores the distinction between the "trust-building" and "conservative" approaches to inflation targeting.

CONCLUSIONS

[28] Because the New Zealand analysis uses the available quarterly data, comparisons between the magnitude of its responses and those of the U.K. or Canada, which use monthly data, are uninformative.

It only exaggerates slightly to suggest that the widespread adoption of inflation targeting has acted as something of a Rorschach test for observers of monetary regimes. Those inclined to be skeptical of all but hard and fast monetary rules have viewed inflation targeting as a form of political window-dressing for the capital market pressures towards price stability at best, and as cheap talk in lieu of credible policy at worst. Alternatively, those who fear crusades for price stability and disregard of output stabilization by central banks have seen in inflation targeting an open declaration of obsession, that nothing but inflation matters. The central bankers adopting inflation targeting regimes have themselves, however, given pride of place to the role of transparency in the inflation targeting framework, both as an end unto itself and as a means to greater accountability and flexibility. Even amongst the adopting central banks, however, there has been some variation in the degree of explicit contracting (with punishment) binding the central bank to strict pursuit of the inflation target.

In essence, the adoption of inflation targeting constitutes a test of whether central bank communication to the public can substitute for strict and simple rules. From the monetary policymaker's point of view, this is the practical aspect of the long-standing academic "rules-versus-discretion" debate. In a world where both central bank information about the economy, and control of it, is imperfect, what matters is when a central banker must deviate from her long-term goal of price stability in the face of uncertain predictions or negative events.[29] Debates over the appropriate target level of inflation or the relative weight of inflation versus output goals may best be seen as political decisions which may be ideological, but which tend to get settled for extended periods, rather than being revisited at every meeting to set interest rates.[30] That is why our framework for characterizing the effects of inflation targeting focusses precisely on — and is able to differentiate the extant interpretations of inflation targeting on the basis of — predictions of how talk by central bankers relates to their behavior in response to shocks.

The evidence presented in this paper indicates that talk by central banks matters after all. Mapping five different interpretations of inflation targeting on to shifts between specific types of central bankers (untrusted discretionary, strictly conservative, trusted OSCR-following) allowed us to create distinct predictions about the changes in the accommodativeness of central bank behavior and in the stability of inflation expectations post-target adoption consistent with each interpretation. The interpretation that inflation targeting simply represents cheap talk, and would be consistent with a move

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[29] See Laubach and Posen (1997b) for statements by central bankers in Germany and Switzerland characterizing their success as the management of such short-run flexibility.

[30] This is consonant with the distinction between goal and instrument independence in Debelle and Fischer (1994), as well as the distinction between constitutional and policy phases of political economy in Dixit (1996).

from conservatism towards greater discretion in (and public distrust of) the commitment to price stability, is rejected for all three economies examined, including for the ERM-exiting United Kingdom (the economy for which the strongest *prima facie* case for such an interpretation could be made). Though central bank talk about inflation targets is not cheap, however, neither is it a literally binding move to "inflation nutter" behavior — there is no evidence that the sort of "inflation-*only* targeting" hoped for or feared by some who hear the words "inflation targeting" was practiced by any of the three central banks considered here. In short, central bank talk to the public can avoid imposing rule-like behavior yet still serve a purpose

Whether talk alone is sufficient to earn the central bank enough trust to allow it to follow the optimal state contingent rule, or whether the talk of inflation targeting represents a shift from discretion towards greater conservatism short of inflation obsession, is not entirely settled, though the bulk of evidence analyzed here supports the trust-building interpretation. Adoption of the Bank of England's inflation targeting framework, which, as described in King (1997) and documented in Bernanke, et al (1999), Chapter 7, goes to great institutional lengths to rely on transparency instead of formal rules, seems to produce exactly the results we would have predicted for the "trust building" interpretation of inflation targeting: a decline in inflation persistence as well as level, an increase in central bank accommodation of real side shocks, *and* a decrease in long-run inflation expectations' response to such accomodation. Similarly, the adoption of inflation targeting by the Bank of Canada looks more like a shift from a discretionary to a trusted OSCR-following type of central bank than a shift to a rabid conservative, on the criteria of central bank accommodativeness and inflation expectation response to real shocks (and inflation persistence did not rise)[31].

On the basis of these results juxtaposed with those for New Zealand, the intepretation of inflation targeting as strict contracting, meaning that not only transparent talk, but also an explicit legal arrangement of strict target enforcement and of central bank punishment for target misses is required to move the central bank towards the OSCR, is rejected. In fact, the Reserve Bank of New Zealand is the central bank of the three examined here which appears most to be moving towards chatty conservatism, not towards the more flexible and trusted OSCR, with the adoption of inflation targeting (though certainly not all the way towards inflation-only targeting). At the same time, the results of inflation target adoption in New Zealand, Canada, and the United Kingdom for the level and persistance of inflation appear to be

[31]Canada's results of inflation targeting are less sharply defined, perhaps due to developments in its budgetary and exchange rate environment over the period. It is useful to remember that whatever central banks do, talk or otherwise, cannot overcome major changes in a country's fiscal and international environments.

essentially the same, though the Bank of England and the Bank of Canada did without the strict accountability apparatus and other institutional constraints exemplified by the Reserve Bank of New Zealand's framework (see Walsh [1995] and Bernanke et al. [1999], ch. 5), and even without full central bank independence for much of the targeting period. A plausible explanation is that the New Zealand inflation targeting framework's emphasis on legal accountability and strict targeting unintentionally produced more conservative behavior than was desired or ultimately necessary. The broader import of this set of results is that increasing central bank transparency through the talk about forecasts and goals embodied in inflation targeting appears to improve central bank response to supply shocks while enhancing public trust of the central bank's long-run target commitment - and it does so without necessarily imposing rule-like inflexibility on monetary policy.

Table 2

Operationalizing Interpretations of Inflation Targeting as
Shifts Between Types of Central Bankers

Interpretation	Trust-building	Strict Contracting	Chatty Conservatism	Inflation-only Targeting	Cheap Talk of the Weak
Shift from	Discretion or Conservatism	Discretion or Conservatism	Discretion	Discretion	Conservatism
Shift to	OSCR	OSCR	Conservatism	Inflation nutter	Discretion
Countries	All	NZ only	All	All	UK
Inflation persistence	decreases	decreases	decreases	decreases	increases
Relative weight on inflation goal	if from Conservatism, decreases	if from Conservatism, decreases	increases	increases	decreases
Response of short-term rate to inflation shocks	if from Conservatism, decreases	if from Conservatism, decreases	increases	increases	increases
Response of long-term rate to inflation shocks	decreases	decreases	ambiguous	ambiguous	increases

Table 3

Time Series Properties of the Inflation Rate
United Kingdom

A. Autocorrelations of inflation rate, pre- and post-target

Sample	1	2	3	4	5	6
Pre-target	0.31	0.20	0.15	0.02	0.18	0.15
Post-target	0.01	–0.27	–0.05	–0.14	0.01	0.07

B. Inflation regression, estimated over pre- and post-target samples

							LM tests		
	Coefficient on:						serial correlation		add'l
Sample	const	π_{t-1}	π_{t-2}	u_{t-1}	R^2	SE	1st ord	4th ord	π term
Pre-target	6.94	0.17	0.03	–0.35	0.19	1.90	0.66	4.47	0.01
	(4.06)	(1.40)	(0.25)	(2.63)			0.41	0.35	0.91
Post-target	3.13	0.01	–0.30	0.04	0.09	1.53	0.32	5.17	0.27
	(4.12)	(0.12)	(2.70)	(0.62)			0.57	0.27	0.61

C. Tests for structural change in the inflation regression

Coefficient on:						Difference:		
Pre-target			Post-target			Post – pre		
π_{t-1}	π_{t-2}	u_{t-1}	π_{t-1}	π_{t-2}	u_{t-1}	π_{t-1}	π_{t-2}	u_{t-1}
0.17	0.03	–0.35	0.01	–0.30	0.04	–0.15	–0.33	0.39
(1.50)	(0.79)	(2.82)	(0.11)	(2.52)	(0.47)	(0.95)	(2.01)	(2.55)

Notes: Data are monthly. The pre-target sample runs from January 1984 through December 1989, and the post-target sample runs from October 1992 through April 1994. (The ERM period from January 1990 through September 1992 is excluded.) Numbers in parenthesis are *t*-statistics. In panel B, the Lagrange Multiplier (LM) test statistics for 1st order serial correlation and for the omission of an additional lagged inflation term are distributed χ^2_1, and the statistics for 4th-order serial correlation are χ^2_4; p-values appear below the test statistics. The results in panel C are based in a regression of inflation on a constant, two lags of inflation, and one lag of the unemployment rate; the independent variables are interacted with a dummy variable equal to one after the adoption of an inflation target in October 1992.

Table 4

Monetary Policy Reaction Function
United Kingdom

Coefficient on:					Difference:			
	Pre-target		Post-target		Post – pre			
r_{t-1}	π^6_t	u_t	π^6_t	u_t	π^6_t	u_t	R^2	SE
0.84	0.25	–0.03	0.09	–0.05	–0.16	–0.02	0.96	2.80
(15.67)	(2.34)	(0.52)	(1.12)	(1.81)	(1.29)	(0.75)		

Notes: Data are monthly. The pre-target sample runs from January 1984 through December 1989, and the post-target sample runs from October 1992 through December 1997. (The period from January 1990 through September 1992 is excluded.) Numbers in parenthesis are *t*-statistics, corrected for heteroskedasticity and third-order serial correlation. The dependent variable in the regression is the overnight rate. The regression also includes an intercept, which is not reported; all variables are interacted with a dummy variable equal to one after the adoption of the inflation target in October 1992.

Table 5

Time Series Properties of the Inflation Rate
Canada

A. Autocorrelations of inflation rate, pre- and post-target

Sample	1	2	3	4	5	6
Pre-target	0.004	–0.117	–0.053	0.102	0.074	–0.249
Post-target	–0.117	0.119	–0.195	–0.062	0.055	–0.134

B. Inflation regression, estimated over pre- and post-target samples

						LM tests		
	Coefficient on:					serial correlation		add'l
Sample	const	π_{t-1}	u_{t-1}	R^2	SE	1st ord	4th ord	π term
Pre-target	5.49	–0.01	–0.19	0.01	2.62	0.61	2.83	1.66
	(2.71)	(0.04)	(0.88)			0.43	0.59	0.20
Post-target	0.02	–0.16	–0.15	0.04	1.86	0.01	5.09	0.04
	(0.01)	(1.87)	(0.75)			0.91	0.28	0.85

C. Tests for structural change in the inflation regression

Coefficient on:				Difference:	
Pre-target		Post-target		Post – pre	
π_{t-1}	u_{t-1}	π_{t-1}	u_{t-1}	π_{t-1}	u_{t-1}
–0.01	–0.19	–0.16	0.15	–0.16	0.34
(0.05)	(1.02)	(1.54)	(0.62)	(1.07)	(1.10)

Notes: Data are monthly. The pre-target sample runs from February 1984 through January 1991, and the post-target sample runs from February 1991 through September 1998. Numbers in parenthesis are *t*-statistics. In panel B, the Lagrange Multiplier (LM) test statistics for 1st order serial correlation and for the omission of an additional lagged inflation term are distributed χ^2_1, and the statistics for 4th-order serial correlation are χ^2_4; p-values appear below the test statistics. The results in panel C are based in a regression of inflation on a constant, one lag of inflation, and one lag of the unemployment rate; the independent variables are interacted with a dummy variable equal to one after the adoption of an inflation target in February 1991.

Table 6

Monetary Policy Reaction Function
Canada

Coefficient on:					Difference:			
	Pre-target		Post-target		Post – pre			
r_{t-1}	π^6_t	u_t	π^6_t	u_t	π^6_t	u_t	R^2	SE
0.93	0.09	–0.08	–0.06	–0.03	–0.16	0.05	0.97	0.54
(41.67)	(1.15)	(1.47)	(1.10)	(0.53)	(1.74)	(0.55)		

Notes: Data are monthly. The pre-target sample runs from July 1984 through January 1991, and the post-target sample runs from February 1991 through September 1998. Numbers in parenthesis are *t*-statistics, corrected for heteroskedasticity and third-order serial correlation. The dependent variable in the regression is the overnight rate. The regression also includes an intercept, which is not reported; all variables are interacted with a dummy variable equal to one after the adoption of the inflation target in February 1991.

Table 7

Time Series Properties of the Inflation Rate
New Zealand

A. Autocorrelations of inflation rate, pre- and post-target

Sample	1	2	3	4
Pre-target	0.65	0.32	0.13	–0.06
Post-target	–0.19	0.09	–0.28	0.17

B. Inflation regression, estimated over pre- and post-target samples

						LM tests		
	Coefficient on:					serial correlation		add'l
Sample	const	π_{t-1}	u_{t-1}	R^2	SE	1st ord	4th ord	π term
Pre-target	4.27	0.64	–0.29	0.49	3.51	0.31	6.48	0.30
	(1.04)	(3.62)	(0.48)			0.58	0.17	0.58
Post-target	2.25	–0.06	–0.02	0.01	0.85	2.51	3.99	0.03
	2.66	(0.35)	(0.24)			0.11	0.41	0.85

C. Tests for structural change in the inflation regression

Coefficient on:				Difference:	
Pre-target		Post-target		Post – pre	
π_{t-1}	u_{t-1}	π_{t-1}	u_{t-1}	π_{t-1}	u_{t-1}
0.64	–0.29	–0.06	–0.02	–0.70	0.27
(4.90)	(0.66)	(0.12)	(0.08)	(1.29)	(0.52)

Notes: Data are quarterly. The pre-target sample runs from 1982Q1 through 1990Q4, and the post-target sample runs from 1991Q1 through 1998Q2. Observations associated with two sharp, one-time shifts in the price level in 1986Q4 and 1989Q3 are deleted. Numbers in parenthesis are *t*-statistics. In panel B, the Lagrange Multiplier (LM) test statistics for 1st order serial correlation and for the omission of an additional lagged inflation term are distributed χ^2_1, and the statistics for 4th-order serial correlation are χ^2_4; p-values appear below the test statistics. The results in panel C are based in a regression of inflation on a constant, one lag of inflation, and one lag of the unemployment rate; the independent variables are interacted with a dummy variable equal to one after the adoption of an inflation target in 1991Q1.

Table 8

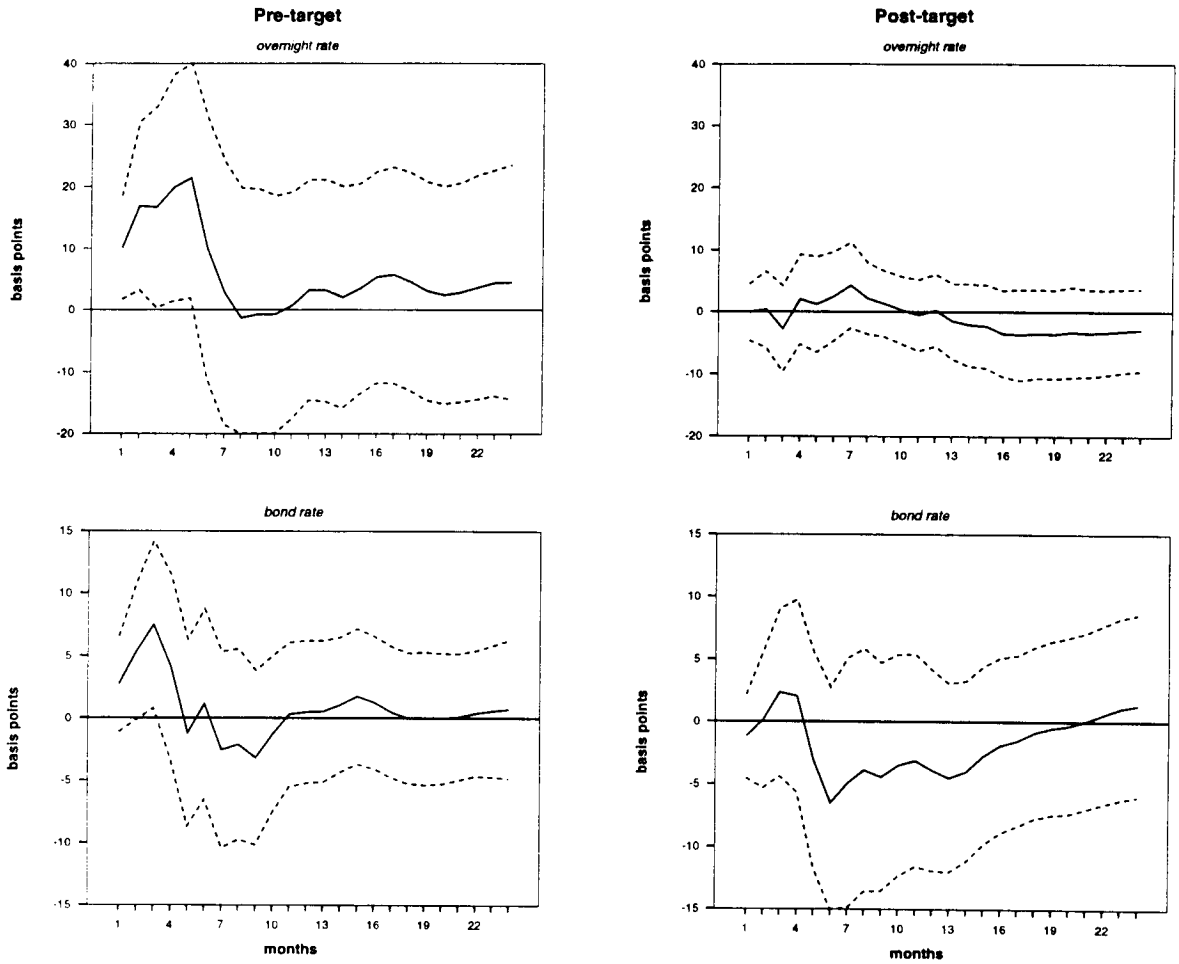
Monetary Policy Reaction Function
New Zealand

Coefficient on:					Difference:			
	Pre-target		Post-target		Post – pre			
r_{t-1}	π^2_t	u_t	π^2_t	u_t	π^2_t	u_t	R^2	SE
0.59	0.42	0.57	0.65	–0.18	0.23	–0.75	0.83	2.06
(7.52)	(2.44)	(1.76)	(2.15)	(2.35)	(0.66)	(2.21)		

Notes: Data are quarterly. The pre-target sample runs from 1982Q1 through 1990Q4, and the post-target sample runs from 1991Q1 through 1997Q4. Observations associated with two sharp, one-time shifts in the price level in 1986Q4 and 1989Q3 are deleted. Numbers in parenthesis are *t*-statistics, corrected for heteroskedasticity and first-order serial correlation. The dependent variable in the regression is the RBNZ discount rate. The regression also includes an intercept, which is not reported; all variables are interacted with a dummy variable equal to one after the adoption of the inflation target in 1991Q1.

Figure 1

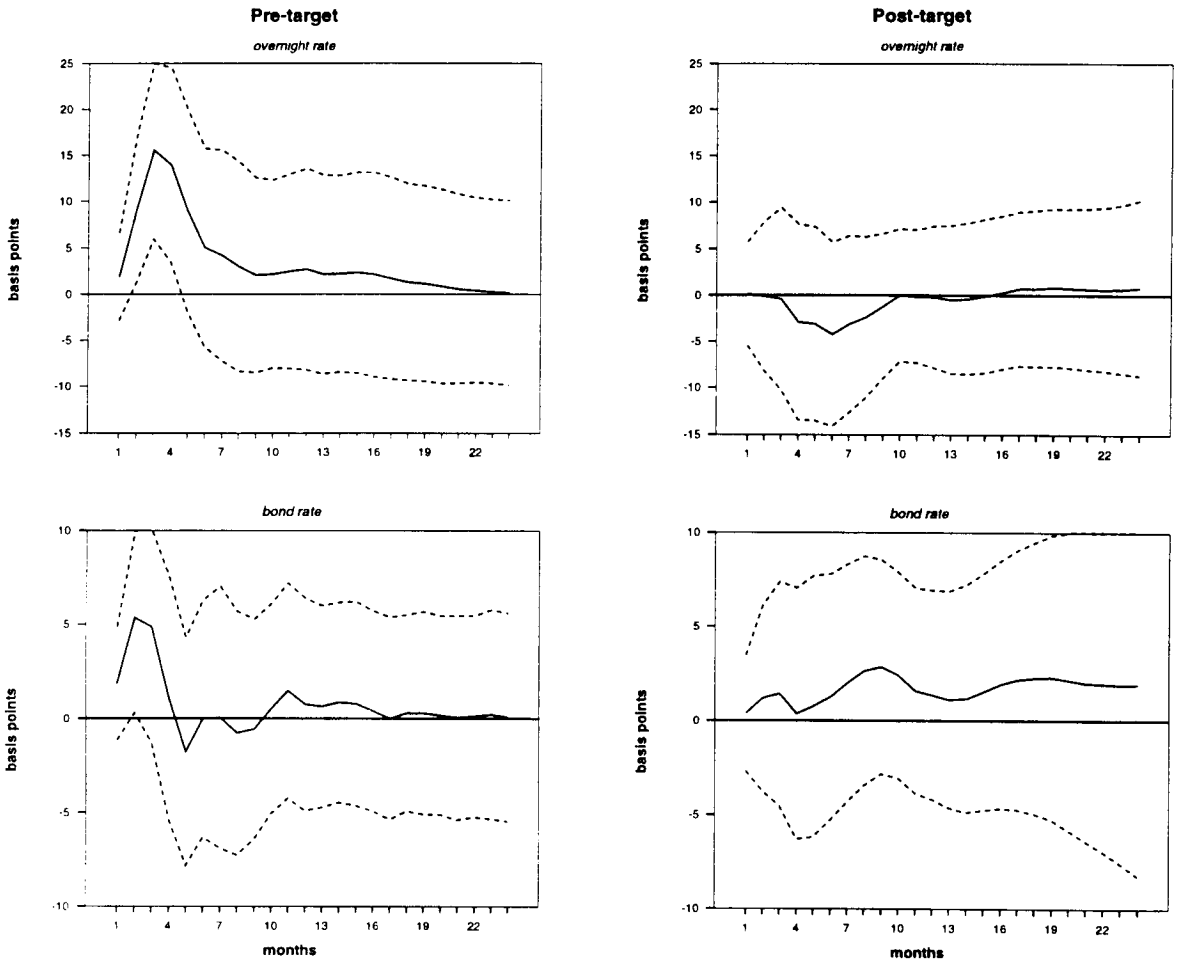
Response of Interest Rates to Inflation Shocks
United Kingdom



Notes: Data are monthly. The pre-target sample runs from January 1984 through December 1989, and the post-target sample runs from October 1992 through April 1994. The period from January 1990 through September 1992 is excluded. Estimated impulse responses functions are computed from a four-variable VAR involving six lags of: the seasonally-adjusted rate of RPIX inflation, the unemployment rate, the three-month interest rate, and the government bond rate. The assumptions used to identify the shocks are described in the text. The 95% confidence intervals are derived from the standard error computed via monte-carlo integration.

Figure 2

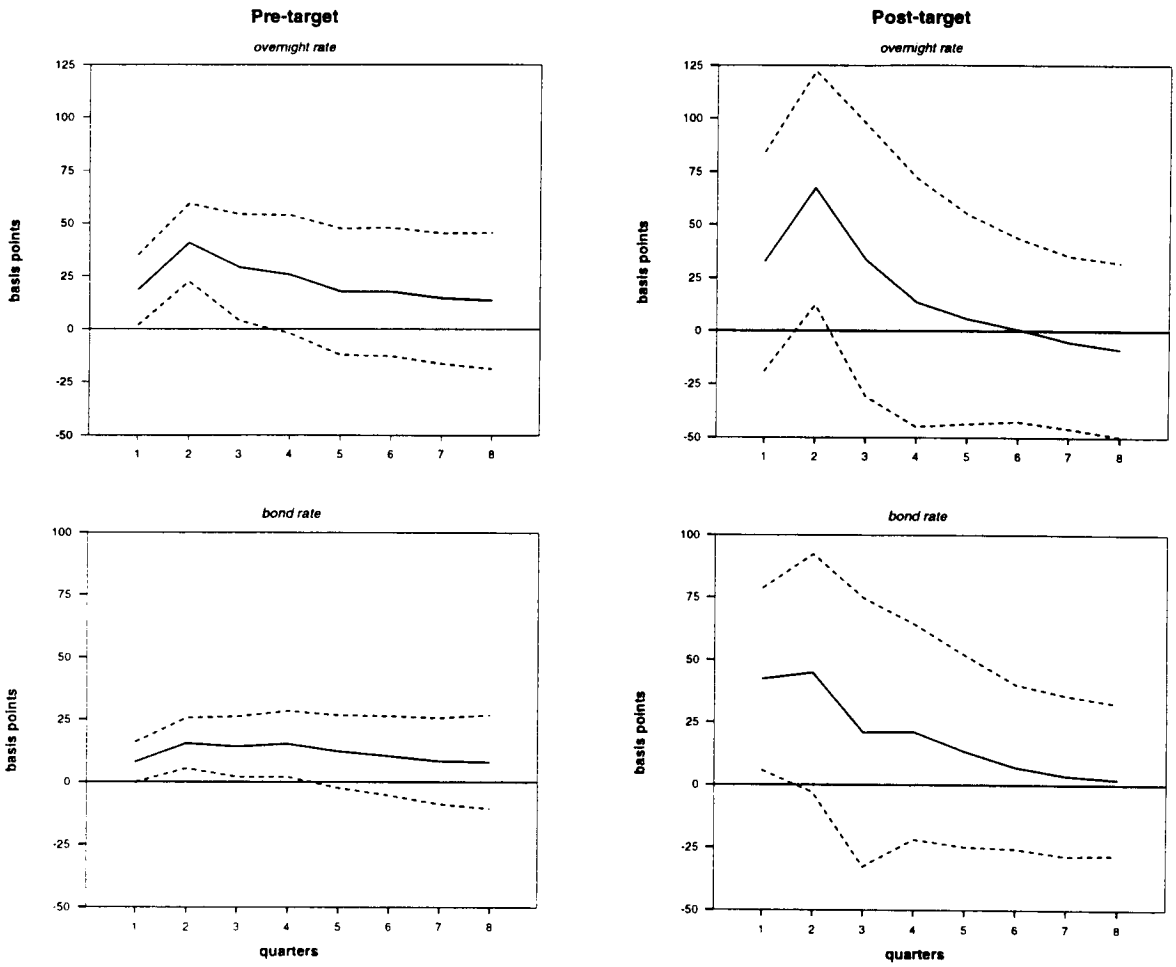
Response of Interest Rates to Inflation Shocks
Canada



Notes: Data are monthly. The pre-target sample runs from July 1984 through January 1991, and the post-target sample runs from February 1991 through September 1998. Estimated impulse responses functions are computed from a four-variable VAR involving six lags of: the seasonally-adjusted rate of CPI inflation (excluding tax effects), the unemployment rate, the call money rate, and the government bond rate. The assumptions used to identify the shocks are described in the text. The 95% confidence intervals are derived from the standard error computed via monte-carlo integration.

Figure 3

Response of Interest Rates to Inflation Shocks
New Zealand



Notes: Data are quarterly. The pre-target sample runs from 1982Q1 through 1990Q4, and the post-target sample runs from 1991Q1 through 1997Q4. Estimated impulse responses functions are computed from a four-variable VAR involving two lags of: the seasonally-adjusted rate of CPI inflation (excluding credit services), the unemployment rate, the discount rate, and the government bond rate. The assumptions used to identify the shocks are described in the text. The 95% confidence intervals are derived from the standard error computed via monte-carlo integration.

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Table 2

Operationalizing Interpretations of Inflation Targeting as
Shifts Between Types of Central Bankers

Interpretation	Trust-building	Strict Contracting	Chatty Conservatism	Inflation-only Targeting	Cheap Talk of the Weak
Shift from	Discretion or Conservatism	Discretion or Conservatism	Discretion	Discretion	Conservatism
Shift to	OSCR	OSCR	Conservatism	Inflation nutter	Discretion
Countries	All	NZ only	All	All	UK
Inflation persistence	decreases	decreases	decreases	decreases	increases
Relative weight on inflation goal	if from Conservatism, decreases	if from Conservatism, decreases	increases	increases	decreases
Response of short-term rate to inflation shocks	if from Conservatism, decreases	if from Conservatism, decreases	increases	increases	increases
Response of long-term rate to inflation shocks	decreases	decreases	ambiguous	ambiguous	increases